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Countdown

December 1985

No. 68

Dr. GOWARIKER LEAVES ON DEPUTATION

Dr. Vasant Gowariker, Director of our Centre is leaving ISRO for a foreign assignment on deputation. He will be a Visiting Scientist at the Stanford University, California, U.S.A. initially for one year. ISRO is sponsoring Dr. Gowariker's deputation.

It may be recalled that Dr. Gowariker took charge as the Director of VSSC from Dr. Brahm Prakash in November 1979. During his tenure as the Director, our Centre recorded a number of achievements of which the first successful launch of SLV-3 (E-2) is perhaps the most significant. In recognition of his service to India's Space Programme, the Government of India honoured Dr. Gowariker with PADMA SHREE in 1984.

Addressing the employees of VSSC on the eve of his departure, Dr. Gowariker, said that the new assignment would provide him with an opportunity to pursue his academic interests unfettered by any administrative and managerial responsibilities. He also said that he had no doubts that Projects like the ASLV and PSLV would be successful if the VSSC community continued to work devotedly as it had been doing till now.

Finally, Dr. Gowariker thanked all the employees of VSSC for their unstinted support and cooperation and for the love and affection they had shown him. "May VSSC grow from strength to strength", he said, concluding his brief speech.

It may be recalled that it was Dr. Gowariker who started this House Journal, COUNTDOWN. We record our gratitude for his encouragement and guidance all through these years and wish him and his family all the best.

SUCCESSFUL STRAP-ON TEST FLIGHT

One of the new technologies being developed for the Augmented Satellite Launch Vehicle (ASLV) is the strapon system. Readers of COUNTDOWN (No.64, 69 and 70) are familiar not only with the basic features of the ASLV strapon system but with some of the jettisoning tests already conducted. Even though the development of the ASLV strapon has been completed, there remained a small lacuna in our programme; it is that we never had launched any vehicle with a strapon system. This gap was bridged on October 16, 1985 when ISRO's first strapon vehicle, designated SO-300-200, was successfully flight tested from SHAR. The designation SO-300-200 signifies the fact that the strapon (SO) test vehicle is derived from two of our Rohini Rockets: RH-300 and RH-200. Specifically, the RH-200 motors are used as the strapons while the RH-300 serves as the 'core' vehicle. Unlike the original RH-200 motors, the strapons need to have 'canted nozzles' (i.e., the nozzles are slightly 'tilted'), the cant angle being about 12°. Hence the RH-200 motors have to be modified. And because of this cant, the ignition system has to be repositioned at the head-end. No modifications are, however, needed on the RH-300 motor used as the 'core'.

This test flight simulates two important features of the ASLV strapon design. One is the 'zero burn mode' in which only the strapons burn initially with the core to be ignited later in the flight. The second feature concerns the delayed separation of the strapons which occurs near the maximum dynamic pressure region. It may be noted that the delayed strapon separation also assures range safety.

Each of the strapon motors is attached to the core at two points: one near the base shroud and the other on the core motor case itself. These joints are the ball-and-socket type. Four explosive bolts, connected through spring thrusters, are used for separating and jettisoning the strapons.

When strapons are used it is necessary to ensure that there is no significant difference between the performance of these strapons. Thus, the propellant grains have been cast from the same propellant mix with thorough quality control over fabrication and inspection procedures. For example, the difference in inert weights of the two strapons is only 0.23 kg., the total weight of the two motors being 185 kg. Similarly, the difference in cant angles is restricted to three minutes of an arc.

SO-300-200 Strap-on Vehicle lifts off.

The payload carried by the Test Vehicle is in two parts: one in the core (95 kg.) and the other in one of the strapons (about 26 kg.). To maintain symmetry, the other strapon carries an equivalent dummy payload. Besides the telecommand destruct system (needed to destroy the vehicle in case of an emergency), the payload includes instrumentation for monitoring a host of parameters: core and strapon motor chamber pressures, strains and temperatures at attachment points, longitudinal and lateral accelerations and so on. The test vehicle is tracked by three theodolites and two radars.

The main purpose of this flight, it may be noted, is to prove that we can master the strapon technology. The successful flight of SO-300-200 strapon test vehicle shows that our main objective has been achieved. Further, the success of the flight has enormously boosted our confidence in designing and fabricating strapon systems. ■

Know About FEAST

FEAST for us in VSSC does not mean only a sumptuous meal or a banquet where food is served in unlimited quantities! More importantly, it means Finite Element Analysis of Structures.

Before we go into the details, let us try to define each of the terms. A structure in this context means any physical object that is composed of organized or interrelated elements. Any physical object has a structure - be it as simple as a pencil or as sophisticated as a multistage rocket. Analysis, of course, refers to the method of studying the nature of something given or of determining its essential features and their relations. That leaves us with the important phrase Finite Element which needs some elaboration.

Theoretically, most engineering problems can be solved by one of two methods : (a) analytical methods or (b) numerical methods. The former methods are useful when all the parameters involved in a problem are known and their relation to one another can be represented in exact mathematical form. For example, if the structure consists only of a single rod of circular cross section, most of the problems associated with it can be solved in this analytical form. Such analytical solutions are very exact and are valid for the entire structure. But in practice the structures of interest are rarely as simple and we cannot normally obtain an analytical solution for complicated structures such as those used in rockets. Thus we have to take recourse to 'numerical methods'. These methods yield approximate numerical solutions to the problems. The accuracy of these solutions can be improved depending on the demands of the problem, but at a cost of computation and time. Of these numerical methods, the finite element method is one of the most powerful tools in the hands of a structural engineer.

The finite element method is based on the process of sub dividing a system into a set of individual components or elements, whose behaviour is readily understood and then re-building the original system from such components to study its behaviour. After all, the idea of building up a given structure by fitting together a number of simpler structural elements is a natural one (see fig 1 for some of these elements). If we know the characteristics and behaviour of these constituent elements, we can determine, in principle, the behaviour of the main structure using this finite element method.

Historically speaking, it was the development work carried out in the structual analysis of aircraft that transformed the finite element method into a practical tool. Further, many scientific and technological advances took place in 1950's which enhanced its versatility as a reliable practical tool of analysis. Two of such advances are: (i) formulation of structural problems in terms of what is known as matrix algebra; in this, the problem is reduced to a set of linear algebraic equations (ii) the introduction of digital computer which made it possible to solve a very large number of equations in a relatively short time. Over the years, the finite element method has grown so versatile that it is now used in many other fields, besides structural engineering. Examples are : fluid mechanics, solid mechanics, heat transfer problems, magnetic field computations and so on.

Before we describe FEAST itself, let us consider what structural systems or structural members (such as trusses, beams, plates, etc.) are expected to do in the context of rocketry. Besides providing the necessary external shapes and load carrying capacity, they do house, support and protect various components like the equipment bay, satellite, and so on. They are also designed to withstand severe environmental conditions like, shock, vibration, extreme temperatures, etc. To build up structural systems required for missions like the ASLV or PSLV, and to evaluate if such built up systems perform efficiently and safely, without actually fabricating the entire hardware and testing the same, the structural engineer wishes to forsee their behaviour through theoretical analysis. This is where the FEAST comes into picture.

FEAST is a general purpose computer program written in the most popular language known as FORTRAN. As computer programmes go, FEAST is 'medium sized' and is capable of handling three dimensional structures. The software package (see COUNTDOWN No.57, January 1985 for "Software Engineering") consists of several modules, each of which performs a specific step in the theoretical analysis (or computation). The heart of FEAST is what is known as the 'Stru-

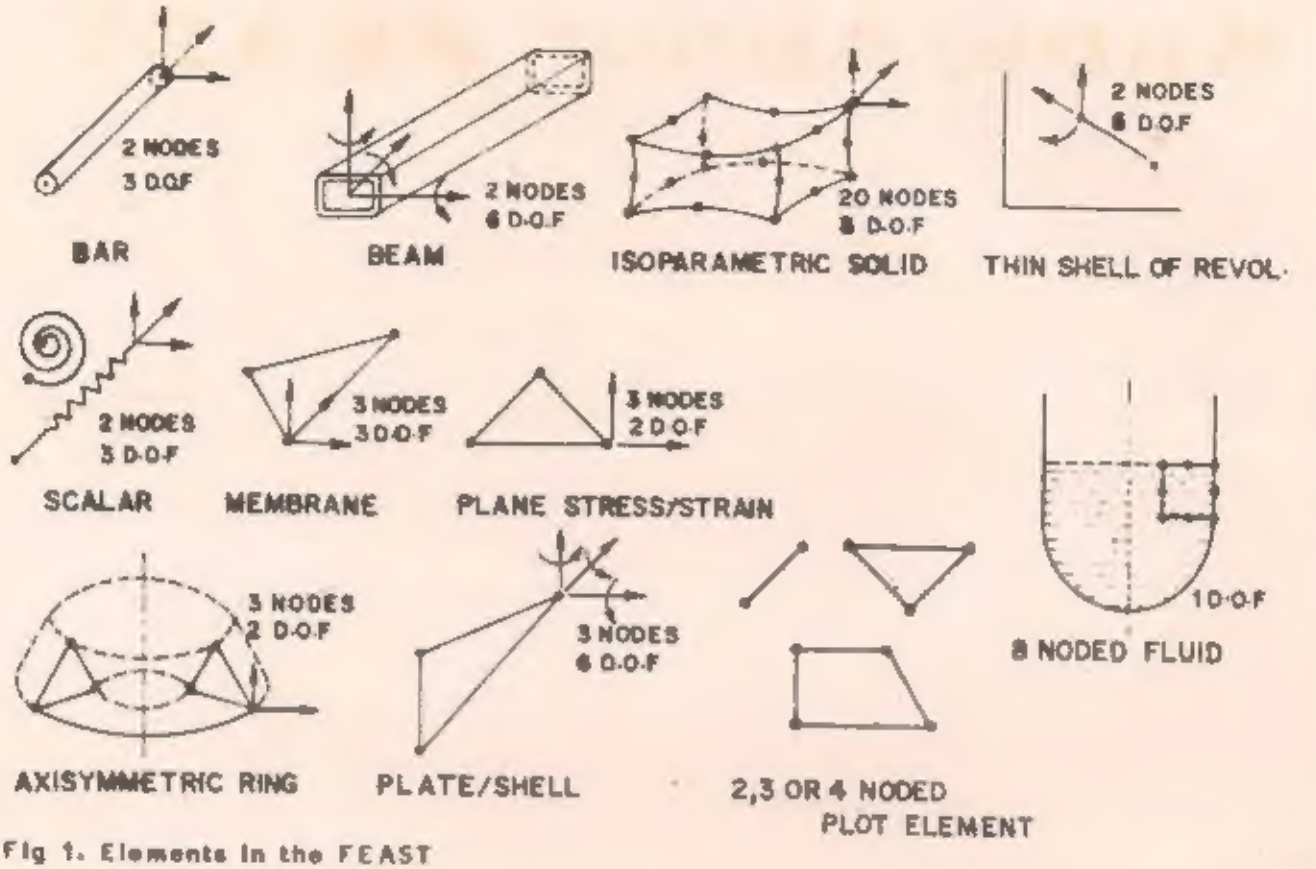

Fig 1. Elements in the FEAST

ctural Element Library'. True to its name, this Library is a depository of a large number of 'basic structural elements'. They are called basic because an engineer can use them as building blocks to synthesize any structure he or she needs (just as a mason uses bricks to build a house). The elements available in this Library are: truss, beam, plane stress/strain, membrane, axisymmetric solid, plate/shell, scalar, thin shell of revolution, brick, layered shell* and curved beam*.

A wide range of practical structures can be 'assembled' from these elements (see fig.1 for the shapes of these elements). For example an interstage structure which involves stiffened shells can be idealised by using beam elements for the stiffeners and a number of plate/shell elements for the shell portion of the structure. Once a practical structure has been synthesised from the elements as described above, the engineer has to study how that structure behaves in a specified environment. This study can be carried out by utilizing the 'analysis capabilities' of FEAST. Here again the capabilities of FEAST are wide-ranging, and cover the following fields of analysis : Static, dynamic, stability, optimization, visco-elasticity, aeroelasticity, sloshing and fracture**.

One would often like to visualize the model structures as well as the results of analysis. This is achieved through the plotting capability of FEAST, which displays the needed information either on graphic screens or on plotters. Some plots obtained through FEAST are shown in figure 2.

FEAST has many features which contribute to its effective and efficient use. Called 'user oriented features', they include automatic generation of nodal and element details, data checks, substructuring, restart and error checks. These features facilitate data preparation, checking of the input data and checking the accuracy of the solutions obtained. They also help solve large-order problems.

FEAST package is operational on CDC-Cyber computer of our Centre. It involves about 35,800 source statements coded into 420 subroutines. The program is

* The elements 'layered shell' and 'curved beam' were supplied by the National Aeronautical Laboratory (NAL), Bangalore

* * The 'fracture' capability was provided by the Indian Institute of Science, Bangalore.

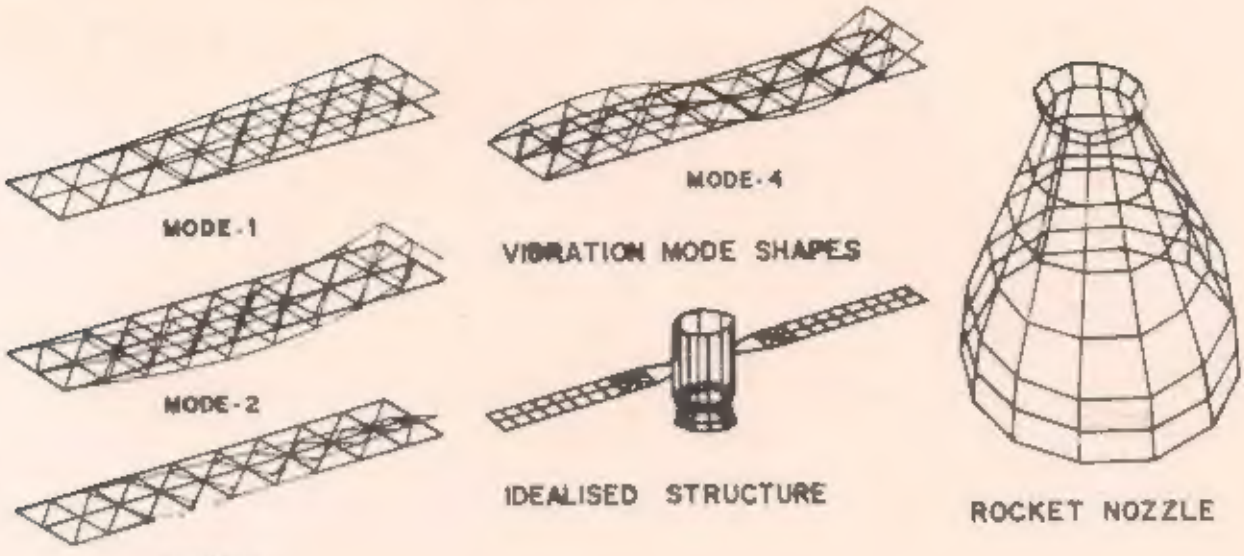

Fig 2. FEAST Plots

documented step by step with about 13,200 comment cards. All the details of the package needed by any user or programmer are supplied in the form of a number of manuals.

FEAST has been and is being used extensively in our Centre for analysing various structural subsytems of ASLV and PSLV. The success of FEAST is evident from the fact that quite a few organisations and institutions have requested for technology transfer of this package. FEAST is made available to them through the usual technology transfer modalities (see COUNTDOWN No.63 July 1985). Our engineers have also conducted FEAST-familiarization courses for the benefit of users from other organisations.

FEAST is being continuously updated by incorporating new elements and capabilities into it. The aim of such efforts is to enhance the scope of the package for analysis of more and more complex structures.

ASLV-STAGE III MOTOR QUALIFIED

THE STATIC TEST FOR QUALIFICATION OF ASLV-THIRD STAGE MOTOR, WAS COMPLETED SUCCESSFULLY AT SHAR ON NOVEMBER 23,1985. WITH THIS, THE FIRST THREE STAGES OF THE VEHICLE ARE FULLY QUALIFIED. NOW THAT THE GROUND FACILITY AT SHAR AND THE GROUND STATIONS FOR TRACKING THE VEHICLE ALSO HAVE BEEN COMMISSIONED, THE PRESENT SUCCESSFUL TEST PUTS US ONE MORE STEP AHEAD IN OUR EFFORT TO REALISE ASLV LAUNCH IN EARLY 1986.

Official Language Implementation

SHIELD FOR VSSC

Controller, VSSC (left) receiving the shield from Shri V.M. Sudheeran, Speaker, Legislative Assembly, Kerala.

The Department of Official Language, Ministry of Home Affairs has awarded VSSC a shield in recognition of the efforts put in by the Centre in implementing the official language policy of the Government of India.

Shri V.M. Sudheeran, Speaker, Kerala Legislative Assembly presented the shield to Shri K. Balakrishna Pillai, Controller, VSSC (Chairman, Official Language Implementation Committee, VSSC) at a conference held in Trivandrum on September 27, 1985 under the Chairmanship of Miss Kusum Lata Mittal, Secretary, Department of Official Language, Ministry of Home Affairs. The Conference was attended by the Heads of Departments of Central Government Organisations, Public undertakings and Nationalised Banks in Trivandrum, Chairmen, Town Official Language Implementation Committees, and Officers-in-overall-charge of Hindi Teaching Scheme in the States of Kerala, Karnataka, Andhra Pradesh, Tamil Nadu, Orissa, Goa and Pondicherry.

KERALA HINDI PRACHAR SABHA HINDI WEEK AND COMPETITIONS

VSSC got also a shield from the Kerala Hindi Prachar Sabha in recognition of the maximum points scored by the participants from the Centre in the competitions held in connection with the State Level 'Hindi Week' celebrated by the Sabha during September 14-20, 1985. The institutional shield for VSSC was received by Dr. S.S. Grover (PSC), Member, Official Language Implementation Committee, VSSC. This was in addition to the individual shields won by our colleagues. COUNTDOWN congratulates all the winners.

The following report in Hindi contains details of the prizes won by participants from VSSC.

वी.एस.एस.सी के लिये राजभाषा शील्ड

27 सितंबर, 1985 पूर्वाह्न को तिरुवनंतपुरम् में भारत सरकार, गृहमंत्रालय, राजभाषा विभाग की सचिव कुमारी कुसुम लता मित्तल की अध्यक्षता में राजभाषा सम्मेलन आयोजित किया गया। इस सम्मेलन में तिरुवनंतपुरम् स्थित केन्द्रीय सरकार के कार्यालयों, सार्वजनिक उपक्रमों तथा राष्ट्रीयकृत बैंकों के अध्यक्ष और केरल, कर्नाटक, आंध्र प्रदेश, तमिलनाडु, लक्षद्वीप, उड़ीसा, गोवा व पांडिचेरी में राजभाषा कार्यान्वयन हेतु गठित नगर समितियों के अध्यक्ष एवं हिन्दी शिक्षण योजना के सभी सर्वकार्यभारी अधिकारियों ने भाग लिया। उक्त सम्मेलन में विक्रम साराभाई अंतरिक्ष केन्द्र को भारत सरकार की राजभाषा नीति के कार्यान्वयन में की गयी प्रगति के सम्मान में गृहमंत्रालय के राजभाषा विभाग द्वारा स्थापित शील्ड प्रदान की गयी।

हिन्दी सप्ताह

राजभाषा हिन्दी के प्रति जागरूकता तथा सरकारी कामकाज में उसके उत्तरोत्तर प्रयोग में प्रगति लाने के उद्देश्य से केरल हिन्दी प्रचार सभा के तत्वाधान में दिनांक 14-9-85 से 20-9-85 तक प्रांतीय स्तर पर "हिन्दी सप्ताह" का आयोजन किया गया। इस आयोजन में केन्द्र सरकार के स्थानीय कार्यालयों/उपक्रमों/निगमों/राष्ट्रीयकृत बैंकों आदि का सक्रिय सहयोग रहा। हिन्दी सप्ताह समारोह के सिलसिले में केन्द्रीय सरकार, राष्ट्रीयकृत बैंक आदि के कर्मचारियों तथा उनके बच्चों के लिए हिन्दी में विविध प्रतियोगिताएँ चलायी गयी। विक्रम साराभाई अंतरिक्ष केन्द्र (वी.एस.एस.सी.) ने इन प्रतियोगिताओं में सक्रिय रूप से भाग लिया और अधिकतम अंक प्राप्त किये जाने पर इसे केरल हिन्दी प्रचार सभा, तिरुवनंतपुरम द्वारा संस्थानिक तथा वैयक्तिक शील्ड प्रदान की गई।

विविध प्रतियोगिताओं में वी.एस.एस.सी. के विजेता निम्न लिखित हैं:–

कर्मचारियों के लिए प्रतियोगिता

अनुवाद

प्रथम पुरस्कार : श्रीमती लीला दासन (वी.एस.एस.सी. केन्द्रीय विद्यालय)

हिन्दी टंकण

प्रथम पुरस्कार : कु. एल.आर. नागेश्वरी (निदेशक का कार्यालय)

द्वितीय पुरस्कार : श्रीमती एम.टी. शारदा (लेखा प्रभाग)

तृतीय पुरस्कार : कु. के. ओमना अम्मा (आइ.जी.ई.पी.)

प्रोत्साहन पुरस्कार : श्रीमती ए.जी. सरस्वती अम्मा (पी.पी.ई.जी.)

हिन्दी में भाषण

द्वितीय पुरस्कार : श्रीमती लीला दासन (वी.एस.एस.सी. केन्द्रीय विद्यालय)

हिन्दी कविता पाठ

प्रथम पुरस्कार : श्रीमती लीला दासन (वी.एस.एस.सी. केन्द्रीय विद्यालय)

हिन्दी निबंध लेखन

प्रोत्साहन पुरस्कार : श्रीमती लीला दासन (वी.एस.एस.सी. केन्द्रीय विद्यालय)

श्रीमती लीला दासन, वी.एस.एस.सी. केन्द्रीय विद्यालय, ने उपयुक्त प्रतियोगिताओं में अधिकतम अंक प्राप्त करके वैयक्तिक शील्ड प्राप्त की है।

Dr.S.S. Grover (left) receiving the Kerala Hindi Prachar Sabha Shield from Shri Shanmugha Vadivelu Mg. Director, State Bank of Travancore.

Standing (l-r): Smt Leela Dasan, Smt M.T. Sarada, Smt A.G.Saraswathy Amma. Sitting (l-r): Kum L.R. Nageswari, Kum K. Omana Amma.

कर्मचारियों के बच्चों के लिए प्रतियोगिताएँ

हिन्दी सुलेख

प्रोत्साहन पुरस्कार : 1. ओ.वी. मिनी, सुपुत्री श्री सी. विजयकुमार, (एल.पी.पी.) 2. शेर्ली ए.तंपी, सुपुत्री श्री ए. तंपी जोसफ (अग्निशमन सेवा).

हिन्दी गीत (समूह)

प्रथम पुरस्कार : 1. एस. लक्ष्मी, सुपुत्री श्री मोहनचन्द्रन पिल्लै एच.टी.सी.आर)2. के.एस. किशोर, सुपुत्र डा: के. सुधाकर राव (पी.एस.एल.बी.)3. नीता रामचन्द्रन, सुपुत्री श्रीमती के.सी. पद्मकुमारी (वी.एस.एस.सी. केन्द्रीय विद्यालय)4. समौतुला श्यामला सुपुत्री श्री एस.के.आर.एस. मूर्ती (एविआनिकी ग्रूप)5. बी. प्रिया, सुपुत्री श्री आर. बालचन्द्रन (ई.एफ.ए.)6. शशि किरण, सुपुत्र श्री के.आर. राव (एम.ए.सी)7. सुरेश कृष्णा, सुपुत्र श्री पी.के. बालसुब्रहमण्यम (एस.ए.सी.)

तृतीय पुरस्कार : 1. शानी शंकर सुपुत्री श्री एन. शिवशंकर पिल्लै (क्यू.सी.डी.)2. सी. संगीता सुपुत्री श्री रामचन्द्रन (आइ.पी.डी.)3. एम. सुनिता सुपुत्री पी.के.आर. नंबियार (आर.एस.आर.)4. एम.जे. मीरा सुपुत्री श्री मनोहरन नायर (ई.एम.डी.)5. एन. पद्मप्रिया सुपुत्री श्री के.वी. नागराजन (एम.ए. सी.)

हिन्दी एकल गान

प्रोत्साहन पुरस्कार: एच. मेरी सुपुत्री श्री टी. सेबास्ट्यन फारणान्डस, (ए.टी.एफ)

एक–पात्राभिनय (कनिष्ठ)

द्वितीय पुरस्कार : सुरेश कृष्णा सुपुत्र श्री पी.के. बालसुब्रहमण्यम (एम.ए.सी.)

हिन्दी कविता पाठ

प्रोत्साहन पुरस्कार : एम.जे. मीरा सुपुत्री श्री एन. मनोहरन नायर (ई.एम.डी.)

WELCOME Dr. Gupta

Dr. Suresh Chandra Gupta succeeds Dr. Vasant Gowariker as the Director of our Centre. Born in 1934 (January 7) Dr. Gupta had his academic training both in India and outside : Banaras Hindu University, Varanasi (B.Sc.), Indian Institute of Science, Bangalore (D.I.I.Sc.) and the University of Pennsylvania, U.S.A. (M.S.E.E. and Ph.D). Before joining the Thumba community in 1965, Dr. Gupta was professionally associated with the Moor School of Electrical Engineering, University of Pennsylvania (In-Charge of the Analog Computer Facility) and the Leeds and Northup Company U.S.A. (Development Engineer).

During his two decades of association with our Centre, Dr. Gupta held a number of important positions: Technical Coordinator, Rohini Group; Head of Control, Guidance and Instrumentation Division; Director, Avionics Group and Associate Director, Vikram Sarabhai Space Centre. Thus it is obvious that Dr. Gupta's appointment as the Director of our Centre is only apt and fitting. COUNTDOWN welcomes Dr. Gupta as the Director, VSSC.

The VSSC community is fully aware of the vital contributions made by Dr. Gupta to the overall growth of the Centre and to the success of the Centre's Projects, foremost among which is the SLV-3 Project itself. If one were to pick only one of his many contributions, one would unhesitatingly choose the control, navigation and guidance systems developed by our Centre for ISRO's launch vehicles.

In recognition of his meritorius work, Dr. Gupta was honoured with National Systems Award (1975) and the "Shri Hari Om Ashram Prerit Dr. Vikram Sarabhai Research Award" (1979).

While congratulating Dr. S.C.Gupta on his appointment as the Director, COUNTDOWN expresses its conviction that the entire VSSC community will unitedly support him in fulfilling the mandate the nation has given to the Centre. ■

SHRI ARAVAMUDAN IS THE ASSOCIATE DIRECTOR

Following Dr. S.C.Gupta's appointment as the Director, VSSC Shri R.Aravamudan has taken over as the Associate Director. Shri Aravamudan is one of the very few senior scientists of ISRO to have been associated with our Centre right from the beginning (1963).

A graduate of Madras University (B.Sc. Physics : 1957), Shri Aravamudan obtained his engineering degree (Electronics) from the Madras Institute of Technology in 1960. Before joining ISRO, he worked in the Reactor Control Section of Department of Atomic Energy for 3 years and was at Goddard Space Flight Centre (NASA), USA for one year. Some of the important positions held by him are : Director, TERLS; Director, Systems Reliability Group (VSSC); Director, ISREL (ISRO Systems Reliability Group). He was also responsible for the development of precision tracking Radars at ISRO.

COUNTDOWN welcomes Shri Aravamudan as the Associate Director.

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